Smart City Participation: Methodological approach to engage schools*

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Abstract

The implementation of Smart Cities and Smart Regions is characterized by a high level of participation. While adults are often involved, children and young people tend to be under-represented. In consequence, ideas and suggestions of children and young people are not considered. This article reports on participation of pupils in a Smart City project. The main contribution is a methodical approach to involve students in a participatory way by developing future scenarios for a smart city. The approach was tested in three different types of schools. A total of 730 pupils were involved. Through the participatory method, a total of 606 ideas for a smart city/smart region were derived.

Keywords

Smart city, smart region, participation, schools, workshop

1. Introduction

Cities are currently facing several challenges, include changes such as the increasing resources scarcity, widespread climate, globalization and demographic change [1]. At the same time, the number of people living in the cities is increasing: By 2050, the urban population is expected to comprise nearly 68 % of the global population [2]. Also, the world population is expected to double [3]. As a result, services and resources in healthcare, to protect the environment, in mobility, and in education may become scarce [4], [5]. In order to cope with these dynamic changes and at the same time maintaining the quality of life in society, strategies and measures for better adaptability become increasingly important. In this context, many municipalities are striving to develop towards intelligent and networked cities, so-called smart cities, in which the use of information and communication technologies (ICT) and disruptive technologies is sought [6]–[9]. In the literature, smart cities are often characterized along different domains as put forward in [7]: smart people, smart governance, smart economy, smart mobility, smart environment and smart living.

Citizen participation is considered a key factor for the success of smart city/smart region initiatives. To ensure that the living conditions can be improved according to the needs of stakeholders, and that the smart city process is successful, it is important to involve them

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in the whole development process [10]–[13]. In general, stakeholder participation along the smart city context is limited due to the heterogeneity of stakeholder groups. In particular, young people, such as pupils, rarely participate in smart city processes [14].

This article explores the needs of young pupils to engage them into democratic processes like the smart city context. We first examine the necessary foundations for participation in Smart Cities and then address the specific pedagogical needs in involving schools. Based on research of participation in the context of the smart city/region project of Linz am Rhein in Germany, a participation method for involving schools was developed. In this way, children and young people of different ages from three different types of schools were able to develop visions for the future of their smart city/smart region. The method and the results from the three schools are presented in this paper. The research was by two research questions: (1) What are the preconditions to involve children and young people in the Smart City process? (2) How should a methodology for involving children and young people be designed? To answer the research questions, a literature review is conducted and the most important aspects of Smart City participation (section 2) and pupil participation (section 3) are analyzed. Based on these findings, the developed method for involving pupils in smart city design is presented in section 4. Section 5 integrates the method and derives future scenarios in three different types of schools. Section 6 discusses the derived results and the application of the developed method. The paper concludes with a summary and an outlook on future research questions.

2. Smart City Participation

The growing challenges and increasingly complex environments of cities and regions require new ways of working together. Municipalities are collaborating with citizens, business and academia. The aim is to effectively contribute and share knowledge and expertise in order to jointly develop new ideas for urban and regional development [12], [13]. Participation refers to the active involvement of various target groups in the development of Smart Cities or Smart Regions [15]. Engaged stakeholders develop concepts together in various participation formats [16]. The term participation refers to the different action structures, forms of participation and interactions within dialog structures, which refers to the interactive cooperation between speaking and listening actors [17]. Through active participation, the objectives of the project can be more closely aligned with the interests of the affected stakeholders (e.g. citizens, businesses). It enables democratical evaluation and helps improving acceptance and trust in the implementing bodies [18]–[21].

Different participation formats are possible: official consultation centers, participation in council meetings, actual decision-making in focus groups or citizen surveys. The specific objectives of citizen participation formats are individual, but follow the same basic principles: (1) Information about public decision-making processes, programs, projects, or services must be transparently available to the general public. (2) Change through active participation improves public acceptance and builds trust in policymaking [22], [23].

Citizens can be seen as experts on their city and therefore play an important role in proactively shaping their city through their own proposals [24]. Citizen participation along

co-creation also holds potential for smart cities, as co-creation can lead to greater satisfaction and acceptance of the developed solutions tailored to the needs of citizens [25].

Digital participation opportunities allow citizens to express their opinions quickly and directly. A major advantage is the independence from time and space constraints. This makes participation easier and more attractive to stakeholders. Hence, citizen participation in smart cities can create general acceptance for the project, promote constructive dialogue and work on an equal footing between the administration and citizens, facilitate identification with the project and positively influence the quality of the entire process [26].

3. Participation in Schools

Learning about democracy is an important aspect of education in schools. Pupil participation in democratic processes has been a topic of discussion since the "United Nations Convention on the Rights of the Child" (CRC) in the early 2000s [27]. Pupil participation is an important criterion for successful and sustainable school development. School is seen as an important place for developing an understanding of democracy. Children and young people should be actively and self-determinedly involved in the decision-making processes of society [28], [29].

In addition to traditional participation, it is important for pupils to be able to influence public decisions. Although participation is often sought in schools, it tends to be characterized by insufficient or symbolic participation. Inadequate participation means that children and young people are informed about decisions but cannot influence their actual implementation. Symbolic participation includes only approaches of pseudo-participation (pupils are consulted but their opinions are not integrated into the decision-making process) or uniform co-determination (pupils are not sufficiently informed but are allowed to have a say). However, neither of these two levels of intensity is sufficient for a general understanding of participation (see section 2). Sufficient participation through democratic co-determination, sufficient information about a situation and personal responsibility is also essential for children and young people [30].

However, participation in schools is not the same as that of adults in traditional workshop situations. Children and young people initially perceive participation differently. Similar to adults, there are pupils who participate in social issues out of their own interest. Others do not want to take responsibility and simply go about their daily school routine. What is needed, however, is a continuous, binding process in school life so that as many pupils as possible can participate in decision-making processes within their abilities. Participation initiatives must be inclusive and non-discriminatory [31]. For children and young people, three arguments for their participation in the school context are key [32]:

- Legal: e.g. UN Convention on the Rights of the Child
- Educational: Developing of self-confidence, a sense of responsibility and independence
- Social: School as a training ground for democratic thinking and behavior, learning about democracy

In particular, educational and social arguments need to be considered when designing participatory programs. Children and young people must first acquire competencies and skills in order to deal with social issues in a self-determined and responsible manner. By familiarizing themselves with a specific issue and participating in participatory activities, children and young people are empowered to deal with new realities as representatives of the younger generation. Democracy and participation go hand in hand. Children and young people are empowered to put democracy into practice through participatory measures in the classroom [27]. School becomes a training ground for acquiring the skills to act and think democratically [33]. Furthermore, the participation measures must be adapted to the age of the children and adolescents. According to Article 12 of the Convention on the Rights of the Child, children should be involved as soon as they are able to form their own opinions, taking into account their age and maturity [32].

However, scholars criticize the fact that it is always the adults who ultimately decide whether or not a child is capable of forming an opinion on social issues. Children can only develop skills if they are trusted with active participation and democracy. Information must therefore be prepared for the different age groups in such a way that all children and young people have a real opportunity to participate (i.e. to understand the information and thus be encouraged to take active action) [34], [35]. This means that key aspects for the integration of participation measures in schools have to be considered. The exchange with teachers is important in order to adapt the offers as much as possible to the heterogeneous target group. In the Smart City project Linz am Rhein, the pedagogical support by the teachers for the participation measures was also a central criterion. The next section therefore presents the method for involving children and young people in the Smart City.

4. Methodical approach to involving schools in Smart City / Region

In social and futures research, future workshops are used as a creative method of citizen participation in democratization processes. Futures workshops bring together different people and their competencies in order to develop visions of the future in a non-hierarchical space. A fixed process structure is defined for the realization of the concept of participatory futures design [36], [37]. Basic steps for the success of a futures workshop are [38]:

1. A future workshop consists of three phases, which are run separately:
    a. Complaint and Critique Phase: The concerns and problems of the current situation are critically analyzed to generate common understanding.
    b. Imagination and Utopia Phase: The current situation is to be overcome through vision and creativity. A vision for the future is developed.
    c. Realization and Practice Phase: The various visions and requirements are condensed into concrete options for action.
2. Future workshops are supported by the contributions and participation of the groups. A facilitator is responsible for methodological preparation and impulse.
3. Future workshops include plenary presentations in an abbreviated form in order to share the results of the group phases with everyone. Fixed time slots

for presentations ensure equal and fair speaking time, so that dominant speakers and the less eloquent are recognized equally.

4. Abstractions in the visions are to be reduced to concrete examples.
5. Focus is put on the problem to be solved and not on side issues.

As part of the participation program along the "Smart City/Region Project Linz", the aim was to provide several workshops to integrate different stakeholders and co-create the smart region vision and strategy for the future. The strategy phase of the Smart Region project in Linz covered various participatory measures such as surveys, interviews and workshops for joint implementation along the key themes of mobility, healthcare, citizen services and urban development. In total, over 700 citizens and entrepreneurs were reached. The workshops were mostly held in the evenings, where only few school children were involved.

To overcome this situation and to involve young people in this important process, the Futures Workshops were modified for schools. Three secondary schools in Linz am Rhein (Germany) were identified for participation. Together with the headmasters, the ideas for futures workshops in the schools were agreed upon, so that the children and young people could contribute to the Smart City project. The concept of the futures workshops was specifically adapted to the school types and pupils. Schools and number of students were: a) High School (Age 14-19): 380 students; b) Integrative secondary school (Age 14-18):270 students; c) Vocational school (Age 15+): 80 students.

4.1. Preparation of the Workshop

While several futures workshops had been held with adults from different target groups based on the steps according to Müllert (2009), specific challenges for pupils and pedagogical aspects needed to be addressed in the structure and implementation of the workshops. The workshops were planned together with the participating headmasters and teachers. The whole process and the respective roles of teachers, project leaders and researchers were defined. In preparatory steps, the objectives of the workshops were first agreed. In the workshops, pupils should develop their own future visions for an intelligent region in the areas of health, citizen services, mobility, urban development and participation. This involved identifying key technologies and implementation measures.

To make it as easy as possible for children and young people to understand the basics of Smart Cities and Smart Regions, simple and easily accessible materials are needed. We developed a two-page handout (see Figure 1), which had at the front page short, easy-to-understand definitions of smart regions and smart cities. The five topic areas of the Smart City project were also briefly described. On the back, the planned tasks were described. This included a brief description in simple language so that pupils could work through the tasks as intuitively as possible during the project day. The tasks and schedules were explained at the beginning. Together with the teachers of the three schools, the tasks and the entire handout were checked for comprehensibility from the pupils' point of view and wording. The handout was made available to the pupils a few days before the project day via the respective digital pupil information systems.

The teachers were essential for the project days, as they can provide pedagogical support to the pupils, while the researchers were responsible for the content aspects of the workshop. However, this required the development of a common understanding when working with pupils. Therefore, a videoconference was held with the teachers beforehand to discuss the main objectives and timetable. A presentation was prepared for the joint discussion and introduction to participation, which was also used during the project days. In addition, a choreography has been developed that defines the exact times for each project day. The necessary utensils and equipment for the rooms were also described.

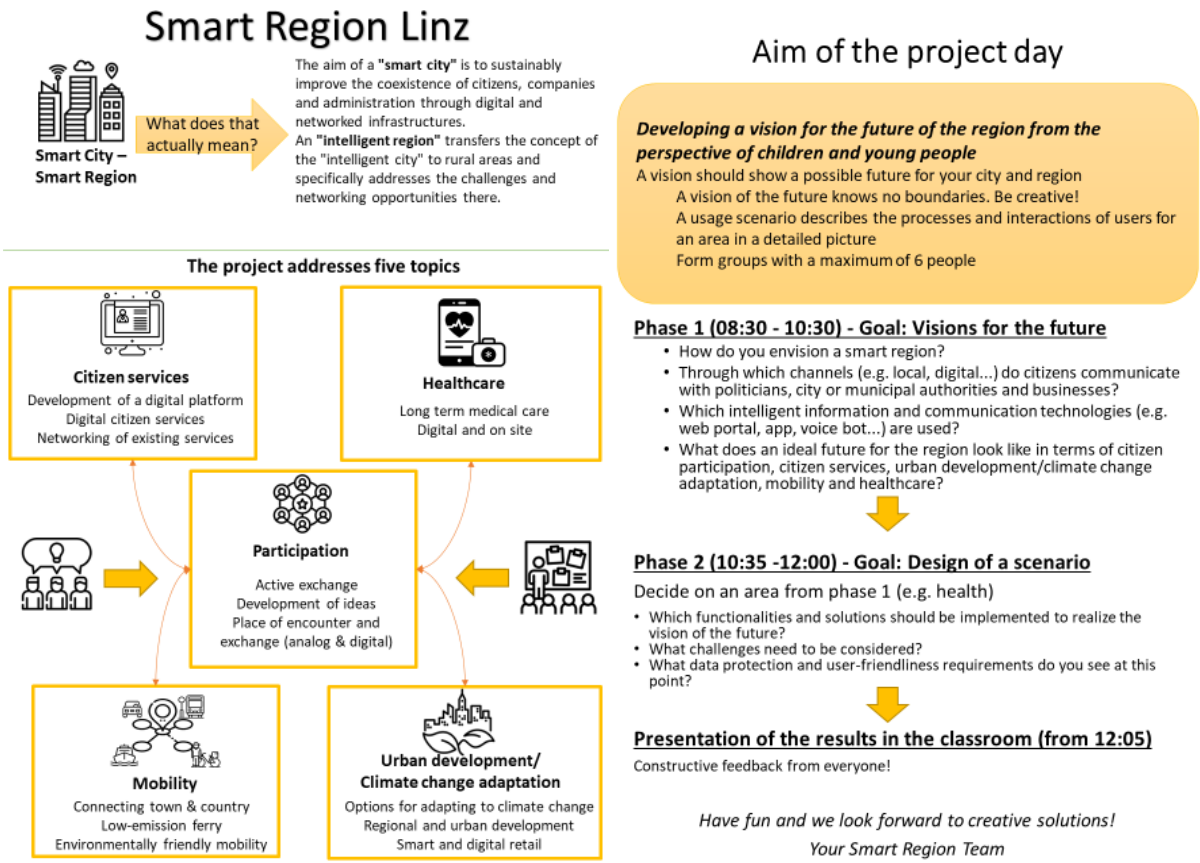

Figure 1: Handout as a simple information brochure

In addition, the timetables were defined with the respective contents, the necessary material resources and personal responsibility.

4.2. Implementation of the futures workshops (project days) in schools

On the project days, the pupils were guided through the choreography step by step. Table 2 shows the respective steps and time sequences on the project days for the development of future scenarios. Together with the teachers, care was taken to ensure that the content of the time sequences was adapted as far as possible to the needs of the pupils. This included alternating periods of concentrated work with targeted breaks. The project day was designed around the regular class periods and breaks so that the pupils could work at their

usual pace. An important goal at the end of the project day was for the groups of pupils to present the results to their respective classes. This allowed all classmates to understand the future visions of all pupils in a class and the intentions behind them. The future scenarios were photographed and then made available to all participating pupils. This allowed pupils to look beyond the class group for more results.

Table 1: Example of a research-accompanying project day in the Smart City project Linz

Time Slot	Content of the session
07:00 a.m.	Preparation phase for the project day: preparing the rooms and materials.
07: 55 a.m.	Welcome and introduction (streamed online into each class) Presentation of the Smart City project with insight and objectives of the workshop. Introduction to the following group work/breakout sessions.
08:20 a.m.	Pupils form themselves into small groups (5-8 people)
08:30 a.m.-10:30 a.m.	Group work Phase 1 – Future vision development on the overall Smart City strategy (groups collect their own thematic focus on Smart City)
In between big break from 09:30-09:45	Development of a rich picture for a Smart Region along key questions: 1. How do you imagine a Smart Region? 2. Which channels (e.g. local, digital...) do citizens use to communicate with politicians, authorities in the municipality and with companies? 3. Which intelligent information and communication technologies (e.g. web portal, app, voice bot...) will be used? 4. What does an ideal future look like in terms of citizen participation, citizen services, urban development/climate change adaptation, mobility and healthcare?
10:30 a.m.	Short break
10:35 a.m.-12:00 p.m. In between big break from 11:20-11:35	Group work Phase 2 – Scenario development on a focused topic: Groups select a specific topic from the rich picture (phase 1), e.g. healthcare and services design/implementation and narrow on an implementation area or solution idea based on key questions: 1. What functionalities and solutions should be implemented to realize the vision of the future? 2. What challenges need to be addressed? 3. What privacy and usability requirements do you see?
12:00 p.m.	Move to the plenary session
12:05 p.m.	Plenary session in the classroom with presentations and group feedback by participants.
12:50 p.m.	Outlook on how the proposals are taken further and what future participation opportunities/formats are offered

5. Results of Workshops and Future Scenario

The results of the posters were documented and quantitatively evaluated. 700 pupils from the three schools submitted a total of 606 ideas, of which 363 were individual ideas for improving their living environment. Figure 2 shows an example of the visions of the future developed by the schools. The pupils' presentations and the evaluation of the posters made it possible to gradually bundle the visions developed.

Along the action areas of the Smart City/Region, 20 ideas were related to participation, 75 to citizen services, 236 to mobility, 29 to health and 293 to urban development, whereby some proposals could be allocated to more than one action areas. Table 3 shows the collected actions. Across all school types, project ideas in the areas of intelligent mobility, revitalization of the city center, climate adaptation and climate protection were frequently mentioned. In particular, the improvement of existing and sustainable mobility options was discussed as a priority by pupils. Supporting all areas of action through digital technologies and intergenerational participation was also discussed intensively, and many ideas for solutions were developed. Although the three types of schools and the pupils involved come from different educational and age groups, similar visions were ultimately brought together. In particular, mobility was identified as a major challenge impacting themselves between their homes and their schools, and many approaches for improvement were derived. Although the schools are located in the city center of the region, many of the children and young people live in the surrounding rural area. Many approaches also included the use of digital technologies to improve services in the city and the region.

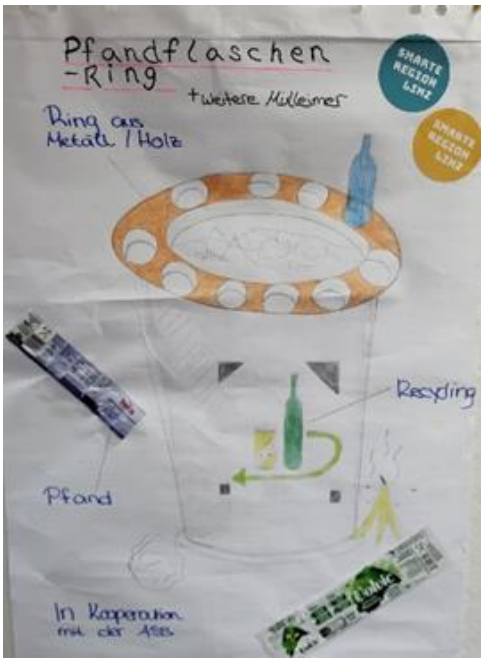

Figure 2: Example posters from the school classes

Table 2: Results of the three project days: Deriving visions for the Smart Region Linz

Vision areas	# proposals	Vision areas	# proposals
Reliable public transportation	55	Opportunities to go out	10
CO2 reduction	46	Improved cycling infrastructure	9
Improvement of mobility through linked means of transport	40	Animal friendliness and Species protection	8
Attractive city	37	Family-friendly region	8
Digitalized mobility	31	Affordable public transportation	8
Promotion of leisure activities	21	Improvement of ferries	7
Improved internet connection	18	Promotion of tourism	7
School-friendly public transportation and mobility	18	Prevention, promotion of leisure activities	7
Youth-friendly city	17	Convenient stops	7
Shopping opportunities	17	Parking facilities	7
Strengthening the regional economy	16	Strengthening cultural life	7
Climate resilience	16	Protecting the environment	6
Accessibility	15	Networked society	5

Clean city	15	Participation	5
Public toilets	15	Digitalized government	4
Digital school, Attractive school and Better equipment for schools	15	Pedestrian friendliness, attractive city	4
Digital Civic platform	13	Accessibility Healthcare	4
Recreational facilities	12	Family-friendly healthcare	3
Use of renewable energies	11	Basic security & combating poverty	3
Digital health care	11		

After processing and sorting the visions of the futures, these were assigned to the topic areas and integrated with the results from the adult engagements. The participation program of pupils provided additional insights, particularly in the three topic areas of mobility, urban development and citizen services. Among other things, the previous participation offers of the Smart City/Region project did not include measures for the modernization and digitalization of schools.

6. Discussion and Conclusion

This research proposed a methodological approach for pupils' participation in different schools. The focus for the method and approach came from a Smart City/Smart Region research, where different participation approaches have already been carried out with different actors. While different target groups have been reached, the number of young people participating was very low. Therefore, the school project days were executed.

However, the participation of pupils is not the same as that of adults. The age groups in the schools are very different and, accordingly, the background knowledge or general knowledge on topics such as Smart City/Smart Region is significantly lower than that of the participating adults. At the same time, however, it is important that such background information on a project such as Smart City/Region is made available to pupils in a way that is appropriate to the target group and in an appropriate language. According to the UN Convention on the Rights of the Child, participation is an important aspect of learning about democracy at school. Through targeted and children-oriented participation approaches, pupils can learn about democracy and participation while making an important contribution to society [27]–[29], [34].

We put forward a methodological approach for participation activities in schools. The approach was used to develop future scenarios of a smart city/region. Pupils were given a first and simple introduction to the Smart City concept. The method was implemented in three different types of schools and age groups. It turned out that the method can be used equally well with younger pupils from a high school and a middle school as well as with young people from vocational classes. The two-page handout summarized the essential background information and made it accessible to the students. In this way, the pupils' focus was on the participatory activity rather than on learning technical terms and background knowledge. A choreography structured the schedule and was available to all organizing actors. Essentially, the methodical approach ensured that, in addition to providing information tailored to the target group, the working hours of the project days were

precisely adapted to typical school hours. The breaks were determined and the work phases were planned around these times. The subsequent joint presentations in the classrooms allowed the pupils to present and discuss their ideas together. In this way, further additions could be integrated and thinking outside the box was encouraged. The 606 ideas were then evaluated and grouped by the research team along the smart city areas participation, citizen services, health, mobility and urban development. Urban development and mobility were particularly prominent, which can be attributed to the behavior and attitudes of the young generation towards sustainability and environmental protection through smart technologies [39].

The methodological approach of developing future scenarios represents a starting point for the preparation and implementation of research and practice-oriented project days in schools. In the further course of the Smart City/ Smart Region project, various participation opportunities such as real-world laboratories are planned in the five specific measures. These will include the co-creative implementation of the selected future visions (for an example of a co-creative approach to an application, see [40]). The modification of the method and the future use of the participatory method will also be researched and tested in other schools and in focus groups with children.

While this approach cannot alone increase ad hoc participation in schools and thus the involvement of pupils in democratic decision-making [14], the results of the workshops can be integrated into the Smart Region project step by step. Further research will evaluate the method in other participation programs with schools. Since community projects such as Smart City/Smart Region are designed to increase the democratic participation of all citizens and since such sustainable solutions affect children and young people, this stakeholder group should therefore be substantially involved in smart city / region actions.

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